Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band	)	GN Docket No. 12-354

COMMENTS OF BARON SERVICES, INC.

Baron Services, Inc. ("Baron") submits these comments in response to the Further Notice of Proposed Rulemaking ("FNPRM") released April 23, 2014 in the above-captioned proceeding.[1] In the FNPRM, the Commission proposed specific rules for a new Citizens Broadband Radio Service in the 3550-3650 MHz band (the "3.5 GHz Band"), including baseline technical standards for the operation of Citizens Broadband Radio Service Devices ("CBSDs") and End User Devices in the 3.5 GHz Band. Baron has a significant interest in this proceeding because it manufacturers S-band broadcast weather radar systems certified by the Commission to operate within the 3500-3600 MHz frequency range.[2]

As detailed herein, in light of the critical public safety services provided by broadcast weather radars, as well as weather radar's great susceptibility to interference from communication signals, Baron again strongly urges the Commission to ensure that Citizens Broadband Radio Service operations in the 3.5 GHz Band do not cause harmful interference to future S-band weather radar systems.[3] Specifically, because the Commission's proposal to accord co-primary status to the Citizens Broadband Radio Service would cause these operations

[1] *See Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band*, Further Notice of Proposed Rulemaking, 29 FCC Rcd 4273 (2014).

[2] *See* Equipment Authorization Identification Nos. NX5VHDD-1000S and NX5KHDD-1000S.

[3] In response to the earlier Notice of Proposed Rulemaking ("NPRM") in this proceeding, *see* 27 FCC Rcd 15594 (2012), Baron filed comments and reply comments in which it similarly emphasized that the Commission must ensure that future S-band weather radar systems are fully-protected from harmful interference from any new uses of the 3.5 GHz Band. Baron incorporates those comments and reply comments into this filing. *See* Comments of Baron Services, Inc., GN Docket No. 12-354 (Feb. 20, 2013) ("Baron Comments"); Reply Comments of Baron Services, Inc., GN Docket No. 12-354 (as amended on Apr. 10, 2013) ("Baron Reply Comments").

to supersede all secondary users (including non-federal radiolocation services),[4] the Commission must adopt a sufficiently stringent out-of-band emission ("OOBE") limit in order to protect adjacent-band operations from harmful interference.

Although Baron understands the importance of identifying additional spectrum for wireless broadband applications, the Commission should not permit new uses of spectrum that could seriously impact other users, particularly where, as here, harmful interference could jeopardize a crucial public safety service. As the Commission has recognized on numerous occasions, broadcasters' weather forecasts and their widespread dissemination of this information to the public play a critical role in protecting viewers' lives and property during weather emergencies.[5] Notably, in recognition of this fact, the Commission described the recent interference to weather radars operating in the 5 GHz band as "unacceptable," and concluded that it "must be eliminated, given the public safety risks."[6] Here, the Commission has a chance to take action before such interference occurs. Accordingly, it must seize this opportunity by adopting technical rules that ensure broadcasters will be able to take advantage of, and the public will be able to benefit from, the cutting-edge dual-polarization technology employed in Baron's S-band weather radar systems.

In contrast to traditional radar systems, which transmit a single horizontally-oriented radar pulse, dual-polarization radars also transmit a second, vertically-oriented pulse, which allows for substantially more accurate and timely severe weather warnings and alerts.

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[4] *See* FNPRM, 29 FCC Rcd at 4307-08 & 4318-19.

[5] *See, e.g., Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 1769, 1796 (2013) ("*5 GHz NPRM*") (noting that broadcasters "inform[] the public on a range of local and regional weather warnings," including "supercell storms capable of developing tornados and severe weather"); FCC Public Safety and Homeland Security Bureau, *Impact of the June 2012 Derecho on Communications Networks and Services: Report and Recommendations*, p. 14 (Jan. 2013) ("The key role broadcasters played during and following the derecho should also be recognized. As in many times of crisis, broadcasters served as 'first informers,' providing the public with information on the storm's path, the damage it caused, and its effects on other communications services.").

[6] *5 GHz NPRM*, 28 FCC Rcd at 1782.

Specifically, dual-polarization allows a radar's signal processor to make direct measurements of the size, shape, and moisture of hydrometeors (*i.e.*, the drops and particles that make up precipitation), which allows it to determine a storm's particular type of precipitation. As a result, dual-polarization radars eliminate the guesswork in attempting to distinguish between, for example, hail and heavy rain, or snow and freezing rain. Dual-polarization radars also forecast precipitation rates far more accurately, which permits more precise predictions regarding the potential for flooding or significant snow accumulation.

These substantial benefits related to dual-polarization technology become even more pronounced if the radar is operating in the S-band. Because this spectrum provides less attenuation, S-band radar systems have a greater ability to look into the heart of a storm, and thereby more accurately gauge the storm's true potential. If the Commission fails to adopt sufficient interference protections, not only would it strand the good faith investments Baron made in reliance on the current allocations for the 3.5 GHz Band and the Commission's grant of S-band equipment authorizations, but it would withhold from the public these significant benefits of dual-polarization, S-band weather radars.

Carefully-crafted and sufficiently-stringent technical rules for Citizens Broadband Radio Service operations are particularly important given that the technical characteristics which permit weather radars to provide critical public safety services also "make[] them very vulnerable to interference."[7] As a result, "harmful interference to radar systems can occur even when there are low levels of interference."[8] Moreover, relevant here is the fact that "radar receivers are not generally robust against low-level interference from non-radar (communication-type) radio

[7] Department of Commerce, *Effects of RF Interference on Radar Receivers*, NTIA Technical Report TR-06-444, p. 82 (Sept. 2006) ("NTIA 2006 Report").

[8] Department of Commerce, *Evaluation of the 5350-5470 MHz and 5850-5925 MHz Bands Pursuant to Section 6406(b) of the Middle Class Tax Relief and Job Creation Act of 2012*, p. 4-11 (Jan. 2013) ("NTIA 5 GHz Report").

signals."[9] Specifically, because radar systems' interference rejection capabilities only work against low duty cycle, pulsed, asynchronous interference (such as that produced by other radars), they are not effective against communication-signal interference, which typically is of a much higher duty cycle. Interference to weather radars is made worse because it "can (and will) cause loss of targets at any distance" as the "loss of targets due to radio interference is not directly related to distance of targets from radar stations."[10] In other words, unlike with communication signals, interference can completely destroy a weather radar's utility, even with respect to nearby weather events that pose the greatest and most urgent threat to the public.

As NTIA has emphasized, the technical characteristics of weather radars "make [even] low-level interference to radar receivers a *very serious problem*."[11] Baron therefore urges the Commission to heed NTIA's advice that, in order "to avoid impairment of radar operations, care must be taken to ensure that radar receivers are not subjected to unnecessary interference from non-radar signals…"[12] Otherwise, the likely resulting interference "will adversely impact data quality, degrade the meteorological products, and compromise the system's ability to accomplish its mission of providing data necessary for public weather forecasting, severe weather warning, and rainfall measurement for flash flood prediction and water management."[13]

As the Commission recognized in this proceeding, in addition to being highly-susceptible to in-band interference, weather radars can experience debilitating interference as a result of the out-of-band emissions of devices operating in an adjacent, or near-adjacent, spectrum band.[14]

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[9] NTIA 2006 Report at xx.

[10] *Id.* at 137.

[11] *Id.* at 1 (emphasis added).

[12] *Id.* at xx; *see* NTIA 5 GHz Report at 4-11 (explaining that "it may be necessary to use more stringent interference protection criteria for radar receivers").

[13] NTIA 2006 Report at 69.

[14] *See* NPRM, 27 FCC Rcd at 15637 ("Transmissions originating in the 3.5 GHz Band may cause harmful interference to other services operating in the adjacent bands."); *id.* at 15637-38 ("Even though small cells are aimed

Accordingly, the Commission must adopt sufficiently stringent OOBE limits for Citizens Broadband Radio Service transmitters. The Commission proposes to apply a limit of 43+10 log (P) – *i.e.*, -13 dBm/MHz – to all emissions outside of the specific channels assigned to CBSDs and End User Devices.[15] As Baron previously detailed, this OOBE limit would be woefully insufficient to protect spectrally-adjacent weather radar systems from harmful interference absent a large exclusion zone around each radar site. In the FNPRM, the Commission similarly recognized that the "[p]rotection thresholds for weak signal receivers," such as weather radar receivers, "may require more stringent OOBE limits…"[16]

Unfortunately, the Commission's proposal in this respect would prevent S-band weather radar licensees from utilizing 80% of the spectrum specified in Baron's equipment certifications because Citizens Broadband Radio Service operations would not be required to comply with a more stringent OOBE limit above 3520 MHz.[17] Nevertheless, Baron appreciates the Commission's desire to protect weather radars and other systems with weak signal receivers, and believes that its proposed approach could represent a reasonable compromise so long as the 3.5 GHz Band technical rules ensure that S-band weather radars operating within the remaining 20 megahertz (*i.e.*, 3500-3520 MHz) will be fully-protected from harmful interference.

However, the Commission's proposed OOBE limit of -40 dBm/MHz at 3520 MHz would fail to adequately protect S-band weather radar systems. While the Commission's alternative proposal clearly would be an improvement, an OOBE limit of -50 dBm/MHz also would fail to ensure that S-band weather radars are fully-protected from harmful interference absent a minimal exclusion zone around each radar site. For instance, as the following chart demonstrates, an

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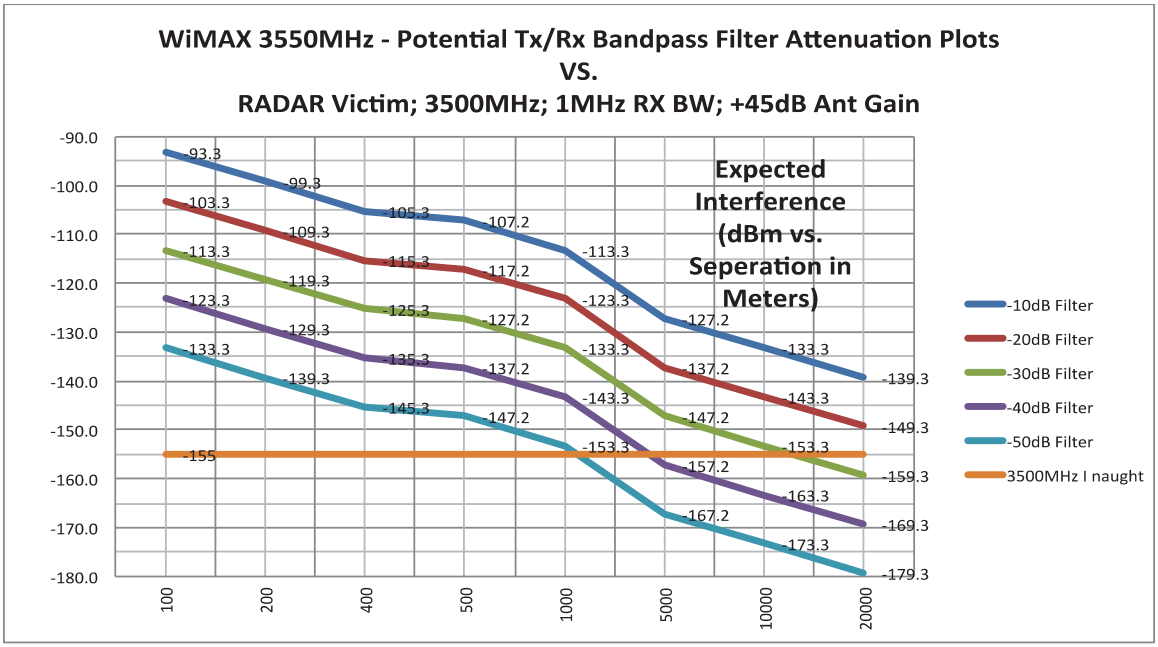
to transmit at low EIRP, once they operate at the close proximity of the frequency band edge, out-of-band emission (OOBE) may cause interference into the neighboring channels or neighboring bands…").

[15] *See* FNPRM, 29 FCC Rcd at 4298.

[16] *Id.*

[17] *See id.* ("[W]e propose this limit specifically for CBSD emissions above 3680 MHz and below 3520 MHz.").

OOBE limit of -50 dBm/MHz would require an exclusion zone of approximately 1,500 meters around each radar site. Baron originally included the below chart in its comments filed in response to the NPRM in this proceeding. Subsequently, as an attachment to its reply comments, Baron submitted a highly-detailed Technical Analysis which similarly demonstrated that the OOBE limits proposed in the FNPRM would be insufficient to protect S-band weather radars from harmful interference absent minimal exclusion zones.[18]



Baron therefore strongly urges the Commission to adopt an OOBE limit at 3520 MHz more stringent than -50 dBm/MHz. As the Commission recognized, due to recent technological advancements, such a requirement would be neither impractical nor unduly burdensome.[19] In fact, currently-deployed equipment appears to already be capable of complying with a more stringent OOBE limit. For instance, the Commission noted that "other mobile broadband service

[18] *See* Baron Reply Comments. This Technical Analysis was prepared by Bill Walker, a pioneer of modern weather radar technology and a former Vice President and Chief Engineer at Baron. Sadly, Mr. Walker passed away last year. As a result, Baron was unable to prepare additional or updated technical analyses for these comments. However, Baron stands ready to assist Commission staff to the best of its ability in determining the exact OOBE limit required to protect S-band weather radar systems from harmful interference.

[19] *See* FNPRM, 29 FCC Rcd at 4298 ("We [] recognize that there has been considerable technological advancement in transmitter and receiver device technologies deployed in the mobile broadband industry over recent years, such that more stringent OOBE limits may be practical without undue burden to manufacturers and operators.").

operations may already be imposing OOBE at the -40 dBm/MHz level…"[20] If existing equipment can attenuate OOBEs by -40 dBm/MHz at band edge, a 30 megahertz transition gap, as the Commission proposes, presumably would permit the same equipment to easily step down to an OOBE limit more stringent than -50 dBm/MHz. Moreover, as noted by the Commission, "the current LTE standards for the use in PCS requires mobiles in 1850-1915 MHz to meet a limit of -50 dBm/MHz in 1930-1995 MHz."[21] If existing equipment can attenuate OOBEs by -50 dBm/MHz with only a 15 megahertz transition gap, presumably, a 30 megahertz transition gap would allow the same equipment to easily comply with a more stringent OOBE limit.

In addition to helping to protect the public by ensuring adequate interference protection for the next generation of weather radars, a more stringent OOBE limit would advance the public interest because it would permit more intensive use of our Nation's finite spectrum resources. For instance, the Commission explained how "a more stringent limit would enable closer proximity of neighboring service operations."[22] At the same time, a more stringent OOBE limit would not unduly burden the users or manufacturers of CBSDs or End User Devices because, with the benefit of economies of scale, the filters needed to comply with such a limit likely would add only a few dollars to equipment costs. Moreover, as representatives from the wireless industry recently underscored, even if a stringent OOBE requirement would marginally increase equipment costs, that added cost would be dwarfed by the value of free or low-cost access to additional spectrum.[23]

Alternatively, if the Commission is disinclined to adopt a more stringent OOBE limit, Baron urges it to reconsider its proposal not to provide interference rights to S-band weather

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[20] *Id.*

[21] *Id.*

[22] *Id.*

[23] *See* CSMAC Unlicensed Subcommittee, *Draft Recommendations on Enforcement*, Submitted for Adoption: CSMAC Meeting, p. 6 (July 24, 2012) ("While prophylactic technology solutions can increase the cost of devices at the margin, unlicensed devices and users typically benefit from zero or low costs for spectrum access…").

radars operating below 3520 MHz vis-à-vis Citizens Broadband Radio Service operations by creating minimal exclusion zones around each radar site. As noted, with an OOBE limit of -50 dBm/MHz at 3520 MHz, the necessary exclusion zone would only need to be approximately 1,500 meters. In addition, as demonstrated in the above chart, even a less stringent OOBE limit of -40 dBm/MHz at 3520 MHz would require an exclusion zone of only 5 kilometers. Notably, these exclusion zones would have an extremely limited impact on the areas in which CBSDs and End User Devices could operate not only because of their small size but also because S-band weather radar systems will only be located well outside metropolitan areas (perhaps 30-40 miles outside of the relevant downtown area).

In sum, Baron urges the Commission to adopt an OOBE limit that fully protects future S-band weather radars operating below 3520 MHz from the out-of-band emissions of Citizens Broadband Radio Service operations. As detailed above, by adopting an OOBE limit at 3520 MHz more stringent than -50 dBm/MHz, the Commission would promote the public interest by ensuring the continued viability of these advanced weather radar systems, while not imposing an unreasonable burden on the users and manufacturers of CBSDs and End User Devices.

Respectfully submitted,

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